

Priority Goals & Actions

Managing Watersheds to Reduce Water Quality Impacts

Water pollution has complex and profound effects on a water system's stability, both from a water quality and an ecological perspective. For the most part, water quality problems in the BBT Basin are interrelated and create similar impacts on waterbodies. One impact can lead to another series of impacts and generate further problems for a waterbody.

Sediment deposition causes perhaps the largest impact on waterbodies. Sources of sediment include runoff from croplands, streambank erosion, and streambank pasturing. Studies have shown that in the mid-19th Century, European agricultural practices led to increased runoff and soil erosion (Knox, 1994).

Extreme flows contribute largely to sediment deposition. Floods generally result in erosion and pollution from materials in the flood

plain. The flow of a stream can be altered both naturally and unnaturally.

The major result of both extreme flows and sediment deposition is frequently **nutrient loading**. Nutrient loading in a lake or stream will alter its chemical structure, which in turn creates other physical and biological problems. The sources, carried downstream with sediment, are mainly barnyard and cropland

- **Dams** – There are 84 large dams in the basin. Dam sizes are classified based on size of the structure and acres of water impounded. There is no accurate count of small dams, but the number is believed to be many times greater than that of large dams.
Impacts of dams – sedimentation, temperature increases, algae blooms
- **Cattle in streams** – It would be difficult to gauge how often cattle are allowed to graze in and around streams, but there are about 6000 farms in the basin.
Impacts of cattle in streams – streambank erosion, nutrient loading, sedimentation
- **Wastewater Treatment Plants (WWTP)** – Levels of nutrients in the discharge of WWTPs are permitted by WDNR staff. There are 57 municipal and industrial WWTP dischargers in the basin.
Impacts of WWTPs – nutrient and BOD loading
- **Cranberry operations** – Cranberry operations use fertilizers and pesticides and discharge warmed water to streams. There are 14,600 acres of cranberry marshes in Wisconsin, producing 52% of the nation's cranberry harvest (Cran Institute, 2001).
Impacts of cranberry operations – nutrient loading, temperature fluctuations, low DO

runoff, industrial discharges, and streambank pasturing. The most harmful nutrients to stream health are nitrogen and phosphorus.

Another impact of extreme flows and sedimentation can be **temperature fluctuations**, which are detrimental to fish species that cannot tolerate extremes in temperature. If sediment levels continue to increase in a lake or stream and the habitat is altered significantly, temperatures have the potential to change.

As temperatures rise and organic materials in the water increase, **dissolved oxygen (DO)** levels tend to decrease. Aquatic species are stressed when DO levels get too low and may not survive. The whole aquatic habitat can be drastically affected.

All of these impacts accumulate to cause **loss of habitat**. Typically, by this time, streambank vegetation is limited, sediment build up has covered spawning beds, temperature and dissolved oxygen fluctuations make the environment unlivable for cold water and even some warm water fish. For the public's health and safety, recreation, and wildlife needs, it is vital to protect water quality in the waterbodies of the Black-Buffalo-Trempealeau River Basin and across the state.



The health of our water is the principle measure of how we live on the land. — Luna Leopold

Sediment Deposition

Sediment deposition has long been a major cause for loss of habitat in area streams and rivers. Specific sources, like streambank erosion, cropland erosion, streambank pasturing, barnyard runoff, wind, and flooding are some causes for these impairments on our waterways. When soils and lands become barren and stripped of vegetation, sediment can be lifted and carried away by both natural and unnatural means. Sediment movement may also occur in stages, meaning sediment may be eroded from higher gradient sources and stored, only to be eroded again.

One way to reduce the amount of loose sediment is by keeping streambanks and shorelines vegetated. This decreases the erosion rate and allows the current to dig a deeper stream channel, improving habitat. However, as streams fill with sediment, gravel bottoms are covered with sand. This can impact fish habitat and natural reproduction events, since rock and gravel bottoms are important spawning areas for game fish like walleyes and forage species like suckers and darters.

Furthermore, when waterbodies gradually fill with sediment, they become shallower. In some cases, light penetrates to the stream's bed, increasing the vegetation and raising the temperature, resulting in a decrease in DO (dissolved oxygen). In others, sediment additions can cloud the water and significantly reduce light penetration, killing plants that exist and further reducing habitat.

Controlling erosion is a key component in improving habitat. In most of the BBT's watersheds, sediment deposition, especially in streams, lakes, and their floodplains, suggest that erosion-causing land practices like those listed above are still problems. However, evidence shows sediment loads have been decreasing in the basin.

The Halfway Creek discharge area near Lake Onalaska, has experienced major stormwater sedimentation related stresses the last few decades due to land use practices in the Lower Black River watershed. The change of hydrology and sedimentation has caused:

- ➡ Streambank erosion
- ➡ Filling of productive wetlands
- ➡ Flooding related problems in the Midway area (Onalaska)
- ➡ Deterioration of area roads and other municipal infrastructure.

Over the last several years, many government agencies have aggressively studied the watershed's hydrology and sediment loading, performed mitigation of previously filled wildlife areas, and designed sedimentation traps. They plan to form a special unit of government to construct, operate, and maintain these sedimentation traps.

Because of changing land use practices and rapid urbanization, these watersheds need a comprehensive water quality and aquatic life survey performed to establish solid benchmarks of their current and potential classification/use. This information then needs to be used to ensure that all WPDES discharge permits (including stormwater permits) adequately protect this resource.



Courtesy of WDNR

Eroded streambanks and visible sedimentation in the Black River.

WPDES – Wisconsin Pollutant Discharge Elimination System; through this system, the WDNR regulates municipal, industrial, and significant animal waste operations discharging wastewater to surface waters or groundwater.

Stream health – the capacity of a stream to repair itself.

Riprap – stones used to construct a protective barrier against erosion.

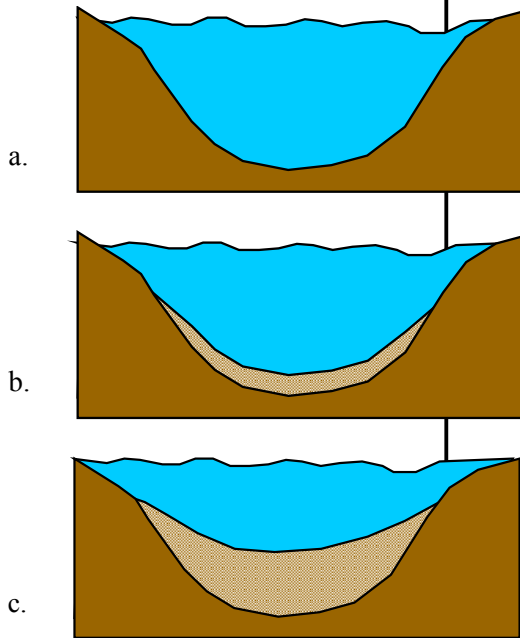


Figure 17 – Sedimentation in a Stream Cross-section; a) Stream has deep channel with little sedimentation. b) Sediment is beginning to settle in the channel. Substrate is covered so spawning cannot take place. c) Sediment has settled in a thick layer making the stream shallow and warming it up.

What the WDNR Is Doing

A major aim of habitat management is to improve “health of streams.” Eliminating dams, protecting stream banks against livestock, and reducing overall sedimentation on some streams are relatively inexpensive measures with great impact in enabling the stream to repair itself (White and Brynildson, 1975). Although more expensive, encouraging flood control and managing stream bank vegetation are essential in allowing the stream to function with a high-quality habitat.

Improving overall stream health is certainly a goal of the WDNR, but it is private landowners who have the most influence on the health of the waterbodies. As a result, the staff encourages dam owners to remove them whenever it is prudent. They collaborate with interested farmers and foresters to put best management practices into use. They enforce and educate the public about shoreland zoning ordinances that prohibit land development too close to the water’s edge.

Some lakes and streams need a little extra work because of severe erosion or because sources of impairments, like dams, cannot be removed. Others, where improvements have been made, can benefit from structures that bring a stream back to health more quickly. In these cases, WDNR staff members look at the best way to enhance the health of the waterbody. This can mean re-seeding or riprapping streambanks or shorelines, or it can be dredging a pond and installing a sediment trap that prevent sediment from entering the waterbody.

What You Can Do

- ➡ Learn about the Conservation Reserve Enhancement Program (CREP), a State-federal conservation partnership using financial incentives to encourage landowners to address water, air, and soil quality in land practices. The BBT is in the CREP eligible area. Visit <<http://www.fsa.usda.gov/dafp/cepd/crep/crephome.htm>>.
- ➡ The Conservation Reserve Program provides cost sharing for buffers, waterways and environmental practices. Contact your local NRCS office.
- ➡ Check out *Wisconsin’s Forestry Best Management Practices for Water Quality*. It’s a field manual, available at a local WDNR office, for loggers, landowners, and land managers.
- ➡ Take a workshop about best management practices for loggers, woodland owners, and resource managers. Visit <<http://www.dnr.state.wi.us/org/land/forestry/usesof/bmp/bmp.htm#Workshops>>.
- ➡ Check out *Understanding Lake Data*, which explains many water quality impacts in the context of lakes. Copies can be obtained through your local UW-Extension office or at <<http://www.dnr.state.wi.us/org/water/fhp/lakes/under/index.htm>>.
- ➡ If your local lake needs habitat improvement, consider a lake grant. Visit <<http://www.dnr.state.wi.us/org/water/fhp/lakes/>>.

Extreme Flows

The flow of a body of water can be defined as the amount of water moving downstream within a given time, and it is the product of velocity and the width and depth of its channel. Extreme flows are usually related to flooding and generally occur when runoff is more than a river or stream channel can hold. The water flows over the river's banks and pours over the floodplain.

Runoff that is sufficient to cause flooding is due to natural events, human activities, or a combination of the two. Severe thunderstorms and long periods of rainfall can produce amounts of water that exceed the soil's capacity. In these cases, water runs off across the ground and into the stream, causing flooding.

Human modifications can also increase flood potential. Some of these include:

- ➡ Removal of vegetative cover – Vegetation slows runoff, allowing water to filter into the soil rather than running off. Examples include deforestation, overgrazing, and mining.
- ➡ Development of impervious areas like driveways and roadways – Runoff volume increases when water cannot soak into the ground.
- ➡ Filling in and draining of wetlands – Wetlands are a natural flood-control mechanism, providing storage of excess water.
- ➡ Dams and other structures designed to prevent flooding – When these structures fail, they increase the destructive power of floods.
- ➡ Stream channelization – This flood-control strategy involves straightening and ditching of a stream channel to transfer water more quickly downstream. Besides eliminating fish habitat, it leads to erosion and magnifies the flood problem downstream.

When flow of a river or stream becomes excessive, increased velocity and water levels can do significant damage to shorelines and riverbanks. Increased energy of the water causes thrashing action against streambanks, eroding and altering the banks. High peak flows transport sediment, changing water clarity from clear to cloudy. The sediment slowly settles and changes the substrate's composition. Altered substrate can adversely affect fish and aquatic insects.

Recently, a property owner was reported to have placed fill in the floodplain behind his house. The fill depth varied from a few inches to as much as five feet. The fill's thickness would cause floodwaters to back up and reach greater depths to flow through this area. During flood events, upstream riparian owners would likely experience greater flood depths and potential property damage because of backwaters associated with this floodplain fill. According to county zoning ordinances, he is required to completely remove the fill.

Floodplain regulations and ordinances limit development in the floodplains of streams. Structures or fill built in floodplains act as barriers to water flowing by. As water hits the structure, it slows down and builds energy and depth as described above. When it pushes by, it does so with more force and at a higher stage. Increased force can also lead to scouring of the substrate and banks, erosion, sedimentation, and all of the impacts that go with them.

Floodplain – the land bordering a stream, built up of sediments from overflow of the stream and subject to flooding when the stream is at high water.

Base Flow – the stable discharge of a stream at normal water level.

Peak Flow – the level of stream flow recorded during storms when surface runoff contributes to existing stream flow.

Substrate – the materials that make up a stream bed.

What the WDNR Is Doing

Flooding causes too much damage and can be too dangerous to depend on only one agency working to prevent it. The WDNR works with other agencies, like the U.S. Geological Survey (USGS) and the Army Corps of Engineers. For example, stream flows have been documented at certain gauging stations and monitored by the USGS staff. Stream flow documentation is needed to assess trends showing the relationship between peak flow and base flow with in-stream habitat and water quality. The WDNR and other agencies can use this data in many ways.

Another way the WDNR tries to prevent major flooding events is working with county Zoning Departments to uphold floodplain regulations and zoning ordinances that limit building in the floodplain. If people were allowed to build or fill in floodplains, the impacts on other property owners would increase dramatically from current levels. The impact on water quality in individual streams would further alter water quality in others and potentially have a cumulative impact on the mainstems of river systems and the property owners around them.

The WDNR continues to try to protect against flooding by seeding and maintaining vegetative borders on streambanks wherever possible, as well as returning channelized streams to their naturally meandering state when they can. They uphold regulations preventing the filling of wetlands, which help to control flooding by providing storage for large amounts of water. The Dam Safety Engineer also regularly inspects structures that impound water to that they are in a good, safe condition. Stormwater Specialists encourage the use of low impact development strategies as well as the development of stormwater detention and retention basins to prevent high volumes of water from increasing flooding issues.

In the role of preventing extreme flows as much as possible, the WDNR protects not only the quality of the water, but also works to protect human life and property from major flooding events.

What You Can Do

- ➡ Learn about the Conservation Reserve Enhancement Program (CREP), which is a State-federal conservation partnership using financial incentives to encourage landowners to address water, air, and soil quality in their land practices. The BBT is in the CREP eligible area of the state. Visit <<http://www.fsa.usda.gov/dafp/cepd/crep/crephome.htm>>.
- ➡ Other cost sharing opportunities are available to private landowners. Contact your local Natural Resource Conservation Service (NRCS) office to find out more about the Conservation Reserve Program (CRP) for buffers, waterways, and environmental practices.
- ➡ Check out *Wisconsin's Forestry Best Management Practices for Water Quality*. It's a field manual, available at a local WDNR office, for loggers, landowners, and land managers.

Courtesy of Jackson County Historical Society



Dams have been in the BBT for well over a century. This one, located at Black River Falls, was made of logs.

If you own property in a floodplain:

- ➡ and no vegetative buffer exists, plant one.
- ➡ and you have an unnecessary structure or fill in the floodplain, remove it.
- ➡ and you have an unnecessary dam or other water-impounding structure, remove it.

If you want more information about how to go about any of these things, talk to a WDNR representative.

Nutrient Loading

Nutrients, like phosphorus and nitrogen, occur naturally in Wisconsin's soils. They are added to the water through point and nonpoint source pollution. The water can dilute nutrients in their natural quantities, but when humans add nutrients to the soil or discharge more than the water can handle, problems arise.

Nitrogen and phosphorus are two essential nutrients for plants and are the primary ingredients in fertilizers used to improve crop yields and green lawns. They are also added to animal feed to supplement their diets and later contribute nutrients to the soil, lowering the amount of fertilizer needed. So, when these nutrient-rich soils on forest or agricultural land wash into waterbodies, the amounts of nitrogen and phosphorus are excessive and unnatural. Soil and nutrients also become NPS pollutants when they run off of construction sites, urban streets, and private lawns.

In addition, phosphorus and nitrogen are constantly being discharged from industrial facilities and wastewater treatment plants. Though these discharges are monitored and limited, they add to the already increasing cumulative nutrient load on the stream.

Nutrient loading is also a major threat to water quality and overall habitat of a waterbody. Excessive amounts of nutrients can cause algal blooms in lakes and streams, which can reduce levels of dissolved oxygen in the water below what fish and other aquatic species need to survive (Holaday, 1995).

As a waterbody receives excessive nutrient loads over a period of time, changes toward a more eutrophic environment occurs. Lake and reservoir basins slowly fill with nutrient-laden sediment and gradually become shallower and recycle nutrients more efficiently. As a result, more plant material is produced and more oxygen is used, leaving less for fish and other aquatic life to use.

Pollutant trading is a relatively new program that uses a contract between two parties to allow one to discharge more nutrients into a waterbody, while the other compensates by decreasing its load. For example, if a wastewater treatment plant (WWTP) cannot meet its nutrient load limits, it can offer incentives to farmers in the same watershed to decrease their load. The farmers may do so by fencing their cattle away from the water, decreasing the amount of fertilizer used on fields, or planting vegetative buffers around the water.

This program can be more cost-effective for the WWTP so it does not have to install mechanisms to meet its discharge limits. It can also help farmers to meet certain goals on their land and minimize their costs in the process. The Lower Chippewa Basin and the Fox-Wolf River Basin are trying this program, and if it succeeds in meeting recommended levels, may be seen in other basins around the state.

Eutrophication – Nutrient enrichment of lakes, ponds, and other such waters that stimulates the growth of aquatic organisms, which leads to a deficiency of oxygen in the water body.

Mesotrophic – an intermediate stage between oligotrophic and eutrophic; bottoms of mesotrophic lakes are often devoid of oxygen in late summer, limiting cold water fish and resulting in phosphorus cycling from sediments.

Oligotrophic – environments, such as soils or lakes, that are poor in nutrients.

Biochemical oxygen demand (BOD) – the amount of oxygen required by microorganisms to decompose the organic wastes in a given volume of water.

Characteristic	Oligotrophic	Eutrophic
Nutrient cycling	Low	High
Productivity	Low	High
Diversity of species	High	Low
Numbers of undesirable fish	Low	High
Water quality	High	Low

Table 7 – Characteristics of Oligotrophic and Eutrophic Waterbodies

What the WDNR Is Doing

To minimize point and nonpoint source contamination due to agriculture, wastewater treatment, construction, stormwater, or

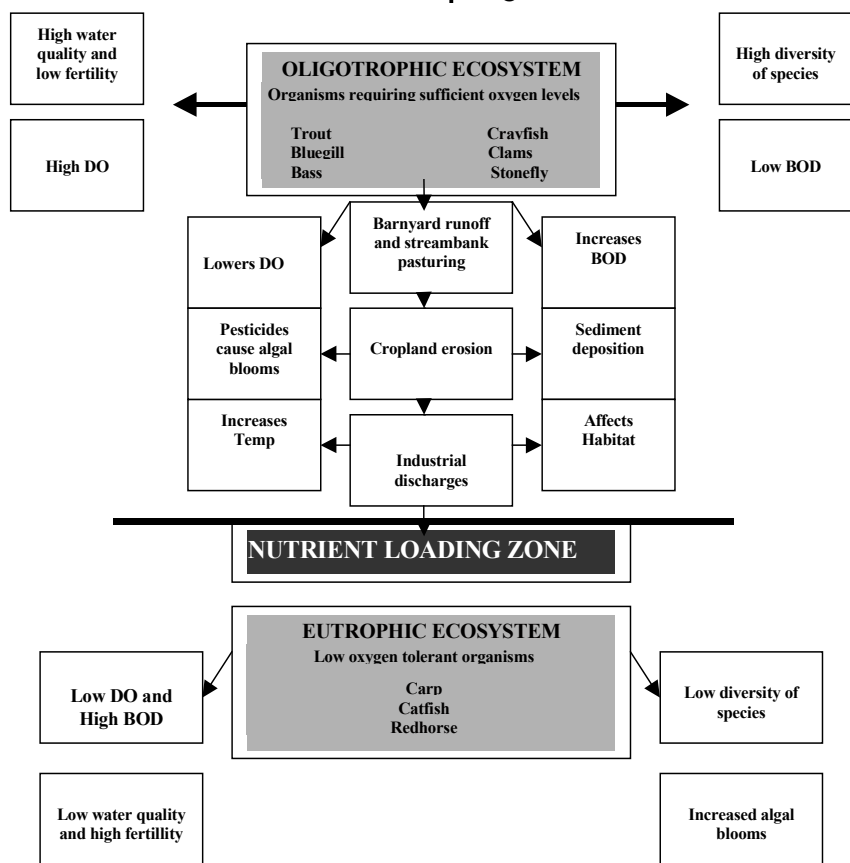


Figure 18 – Long Term Effects of Nutrient Loading on Lakes or Streams (Aging Process of Waterbodies); Oligotrophic ecosystems are relatively young. The transition to eutrophic can take many, many years, but the rate of aging is increased by nutrient loading.

factories, WDNR staff monitors activities in all these areas. Animal waste specialists monitor concentrated animal feeding operations to protect against waste or feed runoff. Wastewater staff sets limits according to state statutes to limit the amount of nutrients that can be released by factories and treatment plants. Stormwater specialists work with businesses and communities to ensure stormwater runoff does not contaminate nearby waterbodies.

The WDNR encourages property owners to take steps to ensure ecological health. Water team staff enforce zoning regulations along shorelines and in floodplains. By having landowners maintain vegetative buffers along streambanks and shorelines, the soil is held more firmly in place and helps to prevent lawn fertilizers from reaching the water. Zoning regulations prevent structures from being built in floodplains, thereby diminishing

human-caused high flows that scour floodplains and take with them large amounts of sediments and their nutrients.

What You Can Do

- ➡ Check with your county zoning office to learn more about shoreline and floodplain zoning regulations in your county.
- ➡ Find out more about programs like pollutant trading, animal waste management, and nonpoint source abatement at <http://www.dnr.state.wi.us/org/water/wm/innovation.html>.
- ➡ Learn about the Conservation Reserve Enhancement Program (CREP), a State-federal conservation partnership using financial incentives to encourage landowners to address resource health in land practices. The BBT is in the CREP eligible area of the state. Visit <http://www.fsa.usda.gov/dafp/cepd/crep/crephome.htm>.
- ➡ Check out *Wisconsin's Forestry Best Management Practices for Water Quality*. It's a field manual, available at a local WDNR office, for loggers, landowners, and land managers.
- ➡ Read up on how nutrient loading in this basin adds to a problem called "hypoxia" that occurs annually in the Gulf of Mexico. Visit these sites: <http://www.rcolka.cr.usgs.gov/midconherb/hypoxia.html> and <http://www.fishingnj.org/artdedzn.htm>

Thermal Fluctuations

No other single factor affects the growth and development of fish as much as water temperature. Aquatic organisms such as fish, aquatic insects, and crayfish, whose body temperatures vary based on their surroundings, are particularly vulnerable to thermal fluctuations. When water temperatures rise, their body temperatures also rise, causing an increase in their respiration rates, which in turn, increases their oxygen demand. Water contains less dissolved oxygen (DO) at higher temperatures so those animals suffer oxygen stress.

A number of sources like industrial discharges and development of impoundments, contribute to thermal fluctuations. Eliminating temperature-changing problems is more difficult than one might think. Impoundments, like dams, levees, and cranberry operations, can significantly raise the temperature of water. Their main purpose of preventing the water from flowing also slows down the small amount of water that continues to flow. By slowing it down and making the stream channel shallower, the water warms up.

Industrial operations use water in their processes, and by exposing it to raised air temperatures and heat creating processes, the water's temperature rises. When this is discharged to a stream, the water may be perfectly clean, but the higher temperature can pollute the stream.

To make the situation worse, it is a proven fact that the effects of toxins, for example heavy metals and pesticides, are frequently magnified by temperature increases. For example, temperature has a direct effect on morbidity (disease). Generally, for every rise in temperature of 10 degrees Celsius, the survival time of fish is cut in half. As a result, poisons become more lethal in waterbodies during the summer.

Robinson Creek flows 25 miles through southern Jackson County. The WDNR's files "indicate that as far back as 1939, fishery workers were concerned with the effects of thermal pollution in Robinson Creek due to impoundment(s)." Historically the creek was a Class I brook trout stream and the quality of the stream has degraded to its current state. Fifteen miles of the stream are cold water and could support a put-and-take trout fishery, while the other ten miles are classified as a warm water sport fishery. This degradation is believed to be due to impoundments – beaver, recreational, and agricultural – on Robinson Creek and its tributaries (Talley, 1989). Removal of impoundments is just one way that we can begin to restore Robinson Creek and other streams in the basin suffering from temperature changes.

Thermal pollution – an emission of heated water that stresses aquatic organisms.

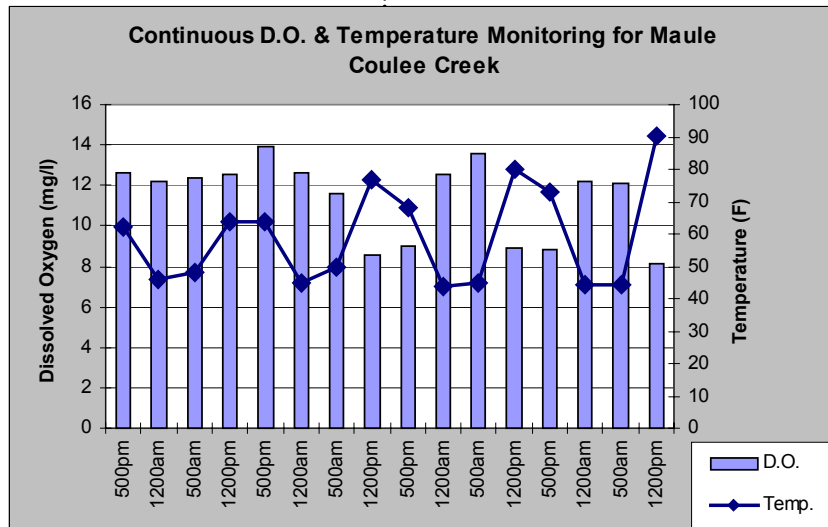


Figure 19 – Notice the correlation between high DO levels and the lower temperature of Maule Coulee Creek in the Middle Trempealeau River sub-watershed levels. For example, the temperature readings in the middle 40s are associated with greater DO levels. There are several contributors to DO fluctuations in addition to increased water temperatures. Organic loading from upstream barnyards are perhaps even greater threats to DO levels.

What the WDNR Is Doing

Waterway and Wetland Permitting staff, especially the Dam Safety Engineer, monitor dams. Large dams are scheduled to be inspected at least once every ten years to ensure that they are being kept in good repair. This is to prevent impacts if the impoundments

fail. If dams are not in good repair or do not appear to serve any useful purpose, they should be taken out, safely. They should gradually be drawn down and when the water has resumed its natural, pre-impoundment state, the dam can be removed with the least possible impact to water quality. Streams that are returned to their natural flow tend to speed up and cool off making the return of fish and fish habitat possible.

Fish Species	Minimum DO Threshold (mg/l)	Preferred Temperature (F)	Preferred Habitat
Brook trout	6	52-61	Cool, clear, well-oxygenated waters with gravel to sandy bottoms
Rainbow trout	5	52-68	Cool, clear, well-oxygenated waters
Channel Catfish	1.2	70-82	Clear, rocky, well oxygenated and warm waters (variety of settings)
Black Crappie	1.4	75-82	Clear to turbid warm waters associated with abundant vegetation and a variety of substrate
Bluegill	1	81-88	Clear to turbid warm waters with a moderate amount of rooted vegetation
Smallmouth Bass	1	52-79	Cool flowing streams & large lakes over gravel to rocky, sandy bottoms with rooted vegetation
Muskellunge	5	34-79	Shallow cool waters of lakes & rivers containing many weed beds and abundant cover (variety of settings)
Johnny Darter	1.5	52-70	Small clear to turbid creeks and streams with mixed sand and gravel substrates

Table 8 – Minimum DO Thresholds & Preferred Temperatures for Various Species of Fish (Becker, 1983); A minimum threshold is a level at which species typically cannot survive. Species in different environments may require different levels due to the variations in chemical, physical, and biological makeup of waterbodies.

The WDNR is required to review and approve all applications for dam abandonment and removal. However, the WDNR cannot require that a dam be removed. Communities and private owners have the option to repair dams that are in disrepair. The WDNR does generally encourage the removal of unnecessary dams not only for the health of the waterway, but also because of the cost of repair and maintenance for the dam owner.

In addition, the WDNR monitors industrial sites for discharges into streams. Stream temperatures are monitored upstream and downstream from discharge sites to determine what, if any, impact is being made on the stream. If thermal impacts are discovered, especially if temperature intolerant fish are known to live and spawn in the stream, then the industry is required to decrease the temperature of their discharged water before it reaches the stream.

What You Can Do

- ➡ To learn more about dams in Wisconsin, visit <<http://www.dnr.state.wi.us/org/water/wm/dsfm/dams/index.html>>.
- ➡ If you have a large or small dam on your property that serves no useful purpose or is an unsafe structure, consider the water quality and aesthetic benefits of removing the impoundment.
- ➡ WDNR grants are available for:
 - Dam removal or repair** – visit <<http://www.dnr.state.wi.us/org/water/wm/dsfm/dams/grants.html>>.
 - Local Water Quality Planning** – visit <<http://www.dnr.state.wi.us/org/water/wm/lwqag.html>>.
- ➡ Check out *Understanding Lake Data*, a publication by UW-Extension, which explains many water quality impacts in the context of lakes and more. Copies can be obtained through your local UW-Extension office or at <<http://www.dnr.state.wi.us/org/water/fhp/lakes/under/index.htm>>.

Dissolved Oxygen

Dissolved oxygen (DO) is one of the most important water quality indicators for fish. Low levels of DO in a waterbody can cause long-term changes in aquatic life and the overall stream habitat.

Fish vary in their oxygen requirements, just as they do in their temperature tolerance ranges, according to species, age, activity, and nutritional state. In general, the minimum DO level needed to support a diverse population of fish is 5 mg/l. Cold water fish generally require a minimum of 6 mg/l, and 7 mg/l during spawning. More tolerant, warm water species can survive in levels below 5 mg/l.

The amount of DO that the water contains varies with the temperature, pressure, and streambank vegetation (Simonson, et al, 1994). Low levels of DO can be correlated with high levels of biochemical oxygen demand (BOD). A stream with a high BOD generally will have a low DO level. Generally, as temperatures increase, DO levels decrease. For example, as the temperature rises throughout the day, oxygen becomes less soluble and the warmer temperatures enhance the growth of algae, causing decomposers like algae, bacteria, and fungi, to use more oxygen. While these daily changes vary considerably, they are more prevalent with seasonal change.

Low DO levels can result from a number of sources, such as barnyard and cropland runoff and point source discharges. In the summer, discharges of organic wastes can impact aquatic life, because of low stream flow and because wastes are less diluted. However, DO levels generally experience an even greater decline during the winter, because of ice cover. The presence of fish and other aquatic organisms reflect both water quality and habitat quality for food, shelter, and reproduction. When impacted by low levels of DO, declining fish populations typically represent a decrease in water quality.

In the table to the right higher water temperatures seem to support extremely low DO levels, but this is not always the case. The DO problem is likely due to a combination of warmer temperatures, BOD, and a lack of re-aeration. Examples are Kenyon, Robinson, and Pine Creeks (Trempealeau County). The streams will not support trout in these stretches. Robinson Creek is located in the midst of several cranberry operations, which may be impacting the stream, and Pine and Kenyon Creeks may be impacted by streambank pasturing and barnyard runoff.

On the other hand, the temperature and DO levels in creeks such as Armour, Trout Run, and Timber Coulee are at sufficient levels to support trout. These streams lack the impoundments and number of pollution sources that might affect the temperature and DO levels.

Dissolved oxygen (DO) – the measure of the amount of oxygen present in a sample of water; usually expressed as milligrams of oxygen per liter of water

Biochemical oxygen demand (BOD) – the amount of oxygen required by microorganisms to decompose the organic wastes in a given volume of water.

<i>Streams</i>	<i>DO (mg/l)</i>	<i>Water Temp (F)</i>	<i># of Sites Averaged</i>	<i>Air Temp (F)</i>	<i>Watershed</i>
Timber Coulee Creek	13.1	56.3	2	74.3	Waumandee Creek
Snow Creek	8.6	62.42	2	76.46	Halls Creek
Armour Creek	8.06	12.41	2	68.54	Lower Buffalo
Vismal Creek	7.2	56.14	2	77.54	Halls Creek
Trout Run Creek	6.7	55.92	3	21.1	Lower Trempealeau
Pigeon Creek	4.24	62.24	5	70	Pigeon Creek
Robinson Creek	4.0	69.8	5	78.62	Robinson Creek
Pine Creek	3.56	68.05	4	82.58	Mid Trempealeau
French Creek	3.14	58.28	5	69.1	Upper Trempealeau
Kenyon Creek	2.75	68.18	1	92	Robinson Creek

Table 9 – Dissolved Oxygen vs. Temperature

What the WDNR Is Doing

Because low DO is frequently caused by changes in temperature, the things that the WDNR does to prevent low levels of DO are similar to what they do to prevent temperature fluctuations. By controlling the discharge of organic loading into waterbodies, DO levels can be improved.

However since temperature and DO levels also change throughout the day and fluctuate seasonally, other measures must be taken. The WDNR uses a high-quality oxygen meter to measure levels of DO in waterbodies. This meter is regularly air-calibrated and wet-calibrated, meaning that it is aligned with the normal conditions of the air and the water so that variations from this can be monitored. Measurements with the meter are generally taken at the time of habitat sampling so that data can be compared. In this way, staff members can determine what causes changes in DO levels.

The WDNR tries to prevent major fish kills by doing things like monitoring DO levels. However, sometimes fish kills result from hazardous spills or organic pollution and cannot be prevented. When significant fish kills are reported, other mechanisms can be put in place. If it is feasible to remove the structures in impounded waterbodies, the WDNR recommends it. With the impounding structure removed, the water typically speeds up and wears a channel for itself, giving it more depth and decreasing the temperature. Aeration can help if removal of an impoundment is not an option. Dredging can also have the effect of deepening a lake or impoundment, but care must be taken in case the sediment is contaminated.

The WDNR also works on other basic stream protection techniques that have been discussed in previous sections, like planting of streambank and shoreline vegetation. As stated in the introduction to this chapter, all of the other impacts can lead to low levels of DO and further, to ultimate loss of habitat. For the WDNR, prevention of these other impacts is the key to maintaining safe levels of DO.

What You Can Do

- ➡ Learn about the Conservation Reserve Enhancement Program (CREP), a State-federal conservation partnership using financial incentives to encourage landowners to address resource health in land practices. The BBT is in the CREP eligible area of the state. Visit <<http://www.fsa.usda.gov/dafp/cepd/crep/crephome.htm>>.
- ➡ Check out *Wisconsin's Forestry Best Management Practices for Water Quality*. It's a field manual, available at a local WDNR office, for loggers, landowners, and land managers.
- ➡ Teachers, lead an aquatic critter search in a local waterbody. To find the activity page for a search, visit <<http://www.dnr.state.wi.us/org/caer/ce/eeek/teacher/critsrch.htm>>.
- ➡ If your local lake needs some help in increasing its DO levels, consider a lake grant. To learn more, visit <<http://www.dnr.state.wi.us/org/water/fhp/lakes/lkgrants.htm>>.
- ➡ River Planning and Management grants are available. Visit <<http://www.dnr.state.wi.us/org/water/fhp/rivers/index.htm>>.

References

- Becker, George C. 1983. *Fishes of Wisconsin*. University of Wisconsin Press: London.
- The Cranberry Institute. 2001. "Facts about the American Cranberry." <<http://www.cranberryinstitute.org/cranfact.htm>>.
- Holaday, Steve. 1995. *Wisconsin's Forestry Best Management Practices for Water Quality: Field Manual for Loggers, Landowners and Land Managers*. Wisconsin Department of Natural Resources, Bureau of Forestry: Madison.
- Knox, James C. 1994. *Post-Settlement Erosion and Sedimentation in the Lower Buffalo River Watershed*. University of Wisconsin Madison, Department of Geography: Madison.
- River Network, The. 2001. "River Quotes." <<http://www.riverwatch.org>>.
- Simonson, Timothy D., John Lyons, and Paul D. Kanehl. 1994. *Guidelines for Evaluating Fish Habitat in Wisconsin Streams*. United States Department of Agriculture: St. Paul.
- Talley, Jim. Wisconsin Department of Natural Resources, Bureau of Fisheries and Habitat. 1989. Robinson Creek file information. Unpublished data.
- White, Ray J. and Oscar M. Brynildson. 1975, reprint. "Guidelines for Management of Trout Stream Habitat in Wisconsin." Wisconsin Department of Natural Resources: Madison.
- Wisconsin Department of Natural Resources, Bureau of Fisheries and Habitat Management. 1990. Stream surveying data from Maule Coulee Creek. Unpublished data.